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ITERATIVE LEARNING CONTROL OF A FLEXIBLE MANIPULATOR

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A project report submitted in partial fulfillment of the
requirements for the award of the degree of
Master of Engineering (Electrical- Mechatronics &Automatic Control)

Faculty of Electrical Engineering
Universiti Teknologi Malaysia

JANUARY 2013

This project report is especially dedicated to my dearest father, mother and family for their love, blessing and encouragement ...

ACKNOWLEDGEMENT

Alhamdulillah, I am greatly indebted to Allah SWT for his mercy and blessings for making this project successful.

I would like to express my deepest gratitude and thanks to Associate Professor Dr. Zaharudin Mohamed, my honourable supervisor, for his continuous guidance, committed support and invaluable advice throughout my study.

My earnest appreciation also goes to all my friends, especially Ziad A Bakri and well wishers that contributed to the success of this study and the knowledge acquired in cause. To you all I say thank you.

I shall forever be grateful to my parents, my siblings, their families and my Imam for their belief in me even when I did not believe in myself and for their unending support, financially; morally, spiritually and emotionally. To them I am highly indebted and words alone cannot describe my gratitude. I pray to ALLAH (SWT) to let you reap the fruit of your labour on me, Jazakum Allau Khyran.

ABSTRACT

Control systems have played an important role in the development of modern life and technology. In many industrial robot applications, they are programmed to do the same task repeatedly. One of the intelligent control methodologies is iterative learning control (ILC). In this thesis, ILC method for a single-link flexible manipulator is proposed to achieve precise tracking control and end-point vibration suppression of the system. The learning is done in a feedback signal and the learning law updates the feed forward input from the error of the previous trial. Three learning algorithms are used: P-type, PI-type and PD-type. The dynamic model of the flexible manipulator is derived using the finite element method. Simulation results of the response of the manipulator with the controllers are presented in the time and frequency domains. The performance of the ILC scheme is assessed in terms of input tracking and level of vibration reduction. It is demonstrated that PD-type ILC provides the highest performance for control of a flexible manipulator.

ABSTRAK

Sistem kawalan telah memainkan peranan yang penting dalam perkembangan teknologi dan kehidupan moden. Terdapat banyak aplikasi robot perindustrian, robot diprogramkan untuk melakukan tugas yang sama berulang kali. Antara methodologi kawalan pintar ialah kawalan pembelajaran secara iteratif (ILC). Bagi thesis ini, method ILC untuk satu pautan manipulator telah dicadangkan bagi mencapai pengesanan kawalan dan titik akhir penyekatan getaran sistem. Pembelajaran dilakukan dengan satu isyarat maklum balas dan kemas kini undang – undang input pembelajaran daripada kesalahan percubaan yang terdahulu. Terdapat tiga kaedah pembelajaran yang digunakan; kaedah-P, kaedah-PI dan kaedah-PD. Model dinamik bagi manipulator fleksibel diperolehi dengan menggunakan kaedah elemen terhad. Keputusan simulasi bagi tindak balas manipulator dengan alat kawalan disertakan dalam domain masa dan frekuensi. Prestasi method ILC dinilai daripada segi input pengesanan dan tahap pengurangan getaran. Ia menunjukkan bahawa ILC kaedah-PD memberikan keputusan yang terbaik bagi mengawal manipulator fleksibel.